CME Article

Immunizations in Hiv-Infected Patients

Claudia Pollet, md, mph; Sindy M. Paul, md, mph; and Robert Morgan, md

Learning Objectives

i. To understand current immunization recommendations for hiv-infected persons.
ii. To describe contra-indications for immunizations for hiv-infected persons.

The Centers for Disease Control and Prevention (cdc) has recognized primary prevention through vaccines as one of the most important public health advances of the twentieth century.[1] Vaccines have modified the common causes of death. One of the most notable achievements of immunizations was the eradication of smallpox. In the late eighteenth century, Edward Jenner noted that dairy workers who contracted cowpox never acquired smallpox. Jenner vaccinated a boy with cowpox and then, six weeks later, with smallpox. The boy never acquired smallpox. Jenner published his findings in 1798, and this form of vaccination quickly gained popularity. Further refinement of the smallpox vaccine and implementation of its use worldwide resulted in the last case of natural smallpox occurring in 1977.[2]

Although the protection that immunizations provide is important for all patients, it is particularly critical in patients with immunocompromising illnesses, such as hiv–aids. In the care of hiv-infected patients, immunizations are an opportunity to prevent serious and potentially life threatening diseases.

In recommending immunizations to hiv-infected patients, it is important to remember the following general principles. First, humoral and cellular responses to antigens are inversely correlated with the patient's cd4 count. Because of this, single-dose vaccines should be given as soon as the patient's hiv status is identified. In cases in which the patient's hiv status is identified late in the course of the disease and immunocompromise is already present (cd4 count is less than 200 cells/uL), consideration should be given to treating the patient with highly active antiretroviral therapy (haart). In the event that the patient will be treated with haart, it may be prudent to delay the administration of one-time immunizations until after immune reconstitution has occurred. Secondly, hiv-infected people generally should not receive live viral or bacterial immunizations. Finally, it is important for the clinician to avoid checking patients' viral load for one month after the administration of immunizations because they may cause a transient rise in these viral load numbers.[3,4]

The immunization schedule for hiv-infected persons, in all age groups, differs from those who are not infected with hiv. Because New Jersey is a

Claudia Pollet, md, mph, is a general internist–public health physician and director of the Division of Hiv and Sexually Transmitted Diseases, Nassau County Department of Health. Sindy M. Paul, md, mph, is medical director of the Division of Aids Prevention and Control, New Jersey Department of Health and Senior Services. Robert Morgan, md, is a senior public health physician and medical director of the Division of Epidemiology, Vaccine Preventable Diseases Program, New Jersey Department of Health and Senior Services and an assistant professor at Umdnj–Robert Wood Johnson Medical School and Umdnj—School of Public Health.

disclosure statement: Claudia Pollet, md, mph; Sindy M. Paul, md, mph; and Robert Morgan, md, have no relationships to disclose.

high prevalence state, ranking fifth in the country in reported adult and adolescent AIDS cases, third in the country in reported pediatric AIDS cases, and having 29,272 persons living with HIV disease, many New Jersey physicians treat HIV-infected patients.[5] This paper provides recommendations on immunizations and alternatives for primary infectious-disease prevention for those infected with HIV. Dosage information about the recommended vaccines is provided in tables 1, 2, and 3.

Pediatric Recommendations

Pediatric immunizations are a vital part of preventing the serious sequelae of many childhood infectious diseases. Because of the immunocompromise that occurs in children infected with HIV, it is important for the physicians caring for these children to provide them with appropriate immunizations according to the schedule recommended by the CDC's Advisory Committee on Immunization Practices (ACIP).[6]

Diphtheria, Tetanus, Acellular Pertussis

All HIV-infected infants and children should receive the diphtheria, tetanus toxoid, acellular pertussis (DTaP) vaccine. Ideally, this series should be given at 2, 4, and 6 months of age, with a fourth dose at 15–18 months. However, if it seems unlikely that the child will be brought back at this time, the fourth dose can be given as early as 12 months, provided that six months have elapsed since the third dose. A final dose of DTaP is given at 4–6 years of age.

Tetanus and diphtheria toxoids (Td) should be given at age 11–12 years, if at least five years has elapsed since the last dose of DTaP.[7]

Haemophilus influenzae b Conjugate Vaccine

The *Haemophilus influenzae* b (Hib) conjugate vaccine series is indicated for all HIV-infected infants and children. The series is routinely begun at 2 months of age because young infants are at increased risk for Hib infection. A second dose of vaccine is given two months later and a third dose two months after that, unless the manufacturer recommendations require only two doses (as with Pedvax Hib and Convax). A booster dose should be administered to children at 12–15 months of age if at least two months has elapsed since the previous dose.

In children between 7 and 11 months of age who have not received any Hib vaccine, two doses of vaccine, two months apart should be administered. This should be followed by a booster dose at 12–18 months of age; again, at least two months should have passed since the previous dose.

Unvaccinated children 12–14 months of age should receive two doses of vaccine, two months apart. Previously unvaccinated children 15–59 months of age should receive a single dose of vaccine. Although an interval of two months between doses of Hib vaccine in the primary series is recommended, an interval of one month is acceptable, if necessary.

Hib conjugate vaccine may be administered simultaneously with DTaP vaccine, polio vaccine (IPV), measles, mumps, and rubella vaccine (MMR), influenza, and hepatitis B vaccines as long as it is given at a different site.

TETRAMUNE™ is the first licensed combination vaccine that protects against diphtheria, tetanus, pertussis, and Hib disease. This vaccine may be used for routine vaccination of infants and should be begun at 2 months of age. The dosing schedule follows that for Hib vaccine, although DTaP is preferred for doses four and five of the five-dose series. TETRAMUNE™ may be used to complete an infant's immunization series started with any brand of Hib vaccine. However, it is preferable to complete the primary series using the same Hib vaccine. Conversely, any DTP vaccine may be used to complete a series.

Using Rifampin chemoprophylaxis for household contacts of a person with invasive Hib disease is no longer indicated if all contacts who are under 4 years of age are fully vaccinated against Hib disease.[8]

Table 1. Immunizations for HIV-Infected Infants and Children

VACCINE	USAGE	DOSE	SITE OF ADMINISTRATION	FREQUENCY
DTaP				
ACEL-IMUNE and Tripedia	Licensed for the 5-dose series	0.5 ml	IM: anterolateral thigh or deltoid	At 2, 4, 6 months, 15–18 months, 4–6 years
Infanrix and Certova	Licensed for the first 4 doses of the series			
Hemophilus b conjugate				
Convax & PedvaxHib		0.5 ml	IM: midlateral thigh or deltoid	At 2, 4, and booster 12–15 months;
HibTITER	Combined with DTP			At 2, 4, and 6 months, booster 15 months;
ActHib				At 2, 4, and 6 months, booster at 15 months and 4–6 years
Hepatitis a				
Havrix: 360 EL.U/ 0.5ml		0.5 ml	IM	Primary: two doses, given one month apart, booster 6–12 months after primary series;
Havrix: 720 EL.U/ 0.5ml				Primary: one dose (month 0), booster: 6–12 months after primary series;
Vaqta				Primary dose at elected time, booster: 6–18 months later
Hepatitis b				
Recombivax-HB	Pediatric/Adolescent formulation	0.5 ml	IM in anterolateral thigh (infants), deltoid (children)	3 doses: at elected time, 1 month and 6 months later; For adolescents: 2 doses at elected time and 4–6 months later;
Engerix-B		10 mcg		3 doses: at elected time, 1 month and 6 months later
Pneumococcal		0.5 ml	IM in anterolateral thigh (infants), deltoid (children)	4 doses: at 2 months, then at 2-month intervals, 12–15 months
Polio		0.5 ml	IM or subcutaneous; anterolateral thigh (infants), deltoid (children)	4 doses: at 2, 4, 6–18 months, and 4–6 years
Rabies				
Imovax Rabies	Postexposure	1.0 ml	IM in anterolateral thigh (infants), deltoid (children)	5 doses: days 0, 3, 7, 14, 30, and 90;
Rabavert				3 doses: days 0, 7, and either 21 or 28

Table 2. Immunizations for HIV-Infected Adults

VACCINE	USAGE	DOSE	SITE OF ADMINISTRATION	FREQUENCY
HEPATITIS A				
Havrix: 360 EL.U/ 0.5ml		0.5 ml	IM in deltoid	Primary: two doses, given one month apart, booster 6–12 months after primary series;
Havrix: 720 EL.U/ 0.5ml				Primary: one dose (month 0), booster: 6–12 months after primary series;
Vaqta				Primary dose at elected time, booster: 6–18 months later
HEPATITIS B				
Engerix-B Recombivax HB		10 mcg	IM in deltoid	At elected time, 1 month and 6 months later
PNEUMOCOCCAL				
Pneu-Immune 23 Pneumovax 23		0.5 ml	IM or subcutaneous	
RABIES				
Imovax Rabies Rabavert	Post exposure	1.0 ml	IM	5 doses: days 0, 3, 7, 14, and 28 in conjunction with rabies immune globulin (RIG) at 20 IU/kg body weight on day 0
Tetanus and diphtheria toxoids adsorbed for adult use		0.5 ml	IM in lateral midthigh or deltoid	3 doses: at elected time, 4–6 weeks, and 6–12 months later, booster every 10 years

Table 3. Influenza Vaccine† Dosage by Age Group: United States, 2001–2002 Season[13]

AGE GROUP	PRODUCT	DOSE	NUMBER OF DOSES	ROUTE**
6–35 months	Split virus only	0.25 ml	1 or 2 doses one month apart***	IM
3–8 years	Split virus only	0.50 ml	1 or 2 doses one month apart ***	IM
9–12 years	Split virus only	0.50 ml	1	IM
>12 years	Split virus	0.50 ml	1	IM

†Contains 15 mg each of A/Ne Caledonia/20/99 (H1N1)-like, A/Moscow/10/99 (H3N2)-like, and B/Sichuan/379/99-like strains.

** For adults and older children, the recommended site of vaccination is the deltoid muscle. The preferred site for infants and children is the anterolateral aspect of the thigh.

*** Two doses administered ≥1 month apart are recommended for children aged <9 years who are receiving the influenza vaccine for the first time.

NEISSERIA MENINGITIDES

With the control of Haemophilus influenzae type B infections, *Neisseria meningitides* has become the leading cause of bacterial meningitis in children and young adults in this country. Between 1994 and1998, approximately two-thirds of cases among people aged 18–23 years were caused by serogroups C, Y, or W135 and, therefore, were potentially preventable with the available vaccine. Even though children under the age of 2 years have the highest risk for sporadic disease, the current vaccine is ineffective in this age group. Since college students, particularly those living in dormitories or residence halls, are at a high risk for meningococcal disease than those of the same age who are not attending college, the ACIP has recommended that students and parents be educated about the risk of disease and about the vaccine. This will allow them to make individualized, informed decisions regarding vaccinations.[9]

HEPATITIS A

There is no blanket recommendation for the use of hepatitis A vaccine in HIV-infected children. In general, this vaccine should be used in children living in communities in which there are high rates of disease (≥ 20 cases per 100,000 population). Ideally, this vaccine should be given at the time that HIV infection is initially identified and again six months later.

Hepatitis A vaccine comes in two formulations: HAVRIX, indicated for children between the ages of 2 and 18 years; and VAQTA, indicated for children aged 2 to 17 years. If an unvaccinated child is exposed to hepatitis A, immune globulin at a dose of 0.02ml/kg should be given intramuscularly within two weeks following the exposure.[10]

HEPATITIS B

Hepatitis B vaccine should be given to all infants, with the first dose given by the time the infant is 2 months old. For infants born to hepatitis B surface antigen–positive mothers, the series should be started within 12 hours of birth and should be accompanied by 0.5 ml of hepatitis B immune globulin (HBIG) at a separate site. The hepatitis B vaccine should be given to the infant again one and six months after the first dose.

The hepatitis B vaccine series should be given to all unvaccinated children through age 18 years.[11] Two-dose series of Recombivax HB 10 ug/dose can be used for adolescents 11–15 years of age, with the second dose given four to six months after the first dose.[12]

INFLUENZA

Influenza vaccine is recommended for all HIV-infected infants and children beginning at 6 months of age. The influenza vaccine should not be given to anyone with an anaphylactic hypersensitivity to eggs or who is ill with an acute febrile illness. The vaccine should be given annually and, optimally, it should be given any time from the beginning of October through mid-November. However, it can be given throughout the influenza season. The influenza vaccine can be administered at the same time as other routine vaccinations as long as it is given at a different site. This vaccine should be given in the deltoid muscle. Infants and children under the age of 9 years should be given two doses at least one month apart. Children aged 9 years or older should receive one dose of the influenza vaccine.[13]

STREPTOCOCCUS PNEUMONIAE

Pneumococcal conjugate vaccine (PCV7) should be administered to all HIV-infected infants and children. Ideally, the series should begin at 2 months of age. This initial dose should be followed by two more doses at two-month intervals, and the fourth dose should be given between the ages of 12 and 15 months. Infants who are born prematurely should receive PCV7 at the recommended chronological age concurrent with other routine vaccinations.

Previously unvaccinated children aged 24–59 months at high risk for pneumococcal infection (including HIV-infected children) should receive PCV7

in the following schedule: two doses of PCV7 administered two months apart followed by PPV23, given at least two months after the second dose of PCV7. PCV7 can be given simultaneously with other routine vaccinations as long as it is given in a separate syringe at a different site.

HIV-infected children who have completed the PCV7 vaccination series before age 2 years should receive one dose of PPV23 at age 2 years, as long as at least two months have elapsed since the last dose of PCV7.[14]

POLIOVIRUS

All children, including those infected with HIV, should receive the poliovirus vaccine. However, only inactivated poliovirus vaccine (IPV) should be used. Oral poliovirus vaccine (OPV) should not be administered to any patients as its use has been associated with all of the indigenous cases reported in the United States since 1979. All children should receive four doses of IPV at ages 2, 4, and 6–18 months and 4–6 years.[15]

VARICELLA–ZOSTER VIRUS DISEASE

Varicella-zoster virus vaccine should be administered only to HIV-infected children who are asymptomatic and not immunosuppressed. Varicella vaccine should not be administered to other HIV-infected children due to the potential for disseminated viral infection. Eligible children should receive two doses of vaccine with a three month or longer interval between doses. The first dose can be administered at age 12 months.[16]

Adult Recommendations

HEPATITIS A

There are no specific recommendations for hepatitis A vaccine in HIV-infected adults. However, many of those at risk for HIV are also at risk for hepatitis A. Hepatitis A vaccine should be used in high-risk groups: injection drug users, men having sex with men, people traveling to endemic areas, people with chronic hepatitis C, and people with chronic liver disease.

There are two formulations of hepatitis A vaccine: HAVRIX and VAQTA. The schedule of both vaccines includes two injections given six months apart. In the unvaccinated person exposed to hepatitis A in the two weeks previous to immunization, immune globulin at a dose of 0.02ml/kg should also be given.[10]

HEPATITIS B

Hepatitis B vaccine should be given to all adults at high risk. As with hepatitis A, many of the risk groups for hepatitis B overlap with those for HIV. Hepatitis B vaccine should be given to injection drug users, men having sex with men, commercial sex workers, men and women with a sexually transmitted disease, and household contacts of HBe antigen carriers. Populations with a seroprevalence 20%, including injection drug users, men having sex with men, and household contacts of HBV carriers, should be screened for hepatitis B markers (hepatitis B surface antibody or hepatitis B core antibody) prior to the administration of the vaccine series.[11]

There are two formulations of hepatitis B vaccine: Energix B and Recombivax. The hepatitis B series includes three doses at 0, 1, and 6 months.[11] The Food and Drug Administration recently licensed the first hepatitis A and B combination vaccine to be used in adults 18 years of age and older. This vaccine, Twinrix, like the hepatitis B vaccine, is given as a three-dose series at 0, 1, and 6 months. Immunogenicity studies in people receiving this vaccine have shown that they have similar responses to persons receiving monovalent hepatitis A and B vaccines separately.[17] The two dose series of Recombivax HB 10 ug/dose can be used for adolescents between the ages of 11–15 years.[12] The second dose of vaccine should be administered four to six months following the first. Measurement of antibody levels in HIV-infected people is recommended at one to six months after the last dose of HBV vaccine. Levels of 10 SRU/ml are considered

protective. Nonresponders should receive one to three additional doses.[11]

INFLUENZA

Epidemics of influenza occur every year during the winter months and are responsible for approximately twenty thousand deaths per year in this country. This infection, although more common among children, causes higher rates of serious illness and death among the elderly and those of any age with a medical condition placing them at high risk for complications. A retrospective study of young and middle-aged infected women enrolled in Tennessee's Medicaid program found that HIV-infected women had a higher attributable risk for cardiopulmonary hospitalizations during the influenza seasons than in the peri-influenza periods. The risk for hospitalization for HIV-infected women was higher than the risk for women with other well-recognized high-risk conditions including chronic heart and lung disease.

Influenza vaccine should be given annually to all HIV-infected adults, except those with contraindications to the vaccine (anaphylactic hypersensitivity to eggs, acute febrile illness). As in children, the optimal period for the administration of the influenza vaccine is from the beginning of October through mid-November. However, the vaccine should be given throughout the influenza season, which in this country generally peaks between late December and early March.[13]

STREPTOCOCCUS PNEUMONIAE

Although there is no controversy that the pneumococcal vaccine should be given to persons with HIV infection,[18] there are differing opinions as to when it should be given. Kovacs and Masur[3] state that the vaccine should be given within three months of the diagnosis of HIV infection. According to the CDC[16] and Barlett and Gallant,[4] the vaccine should be given to those with CD4 count ≥ 200 cells/uL. If the patients have a CD4 count of less than 200 cells/uL and are starting HAART, vaccination should be delayed until after immune reconstitution occurs. Revaccination of the HIV-infected person should be given at five-year intervals.[18]

TETANUS AND DIPHTHERIA

There is no specific recommendation for the use of the tetanus diphtheria (Td) vaccine in HIV-infected adults. However, as for all adults, those who are HIV-infected should be given a Td booster every ten years after completion of their primary series.[19]

Contraindications and Controversies

There are some important exceptions to the use of vaccinations in HIV-infected patients. The first to note is the measles, mumps, and rubella (MMR) vaccine. The CDC's ACIP[3] recommends MMR for all asymptomatic HIV-infected patients who do not have evidence of severe immunosuppression.

This vaccine is not recommended for HIV-infected patients with evidence of severe immunocompromise for several reasons. First, there has been a recorded case of progressive measles pneumonitis occurring in an AIDS patient that was severely immunocompromised at the time of vaccine administration. Secondly, evidence indicates a diminished antibody response to measles vaccine among severely immunocompromised HIV-infected people and people who are immunocompromised from other etiologies. This suggests that the vaccine may not provide protection. Lastly, the incidence in this country of measles is presently very low.[4]

Severely immunocompromised patients and other symptomatic HIV-infected patients who are exposed to measles should receive immune globulin (IG) prophylaxis regardless of vaccination status because they may not be protected by the vaccine. For patients receiving intravenous immune globulin (IGIV) therapy, a standard dose of 100–400 mg/kg should be sufficient to prevent measles infection if the IGIV is administered within three weeks of the exposure. For patients exposed to measles longer than three weeks, an additional dose should be considered after they receive a standard IGIV dose.[20]

VARICELLA

Limited data regarding the safety and efficacy of using varicella vaccine among HIV-infected adults are available, and no recommendation for its use can be made for this population.[16] HIV-infected people who have been exposed to a person with either acute varicella or herpes zoster, ideally should be given varicella zoster immune globulin (VZIG) within forty-eight hours of exposure. However, VZIG can be given up to ninety-six hours after exposure. The dose of VZIG, 125 U/10 kg of body weight up to a maximum of 625 U, should be given intramuscularly.[21]

RABIES

New Jersey, including the urban areas in the state, has an epizootic of rabies in the raccoon population. Rabies can be transmitted to humans from wild animals, particularly raccoons, foxes, skunks, groundhogs, bats, and unvaccinated domestic animals.

Immunosuppressed persons who are at risk for acquiring rabies from an animal contact should be vaccinated by the intramuscular route. Exposed patients should also receive local wound care and human rabies immunoglobulin (RIG) 20 IU/kg body weight. If feasible, full dose should be infiltrated around the wound(s), otherwise, any remaining volume should be given intramuscularly at a site distant from the wound.[22,23]

For further information, the New Jersey Department of Health and Senior Services' (NJDHSS) "Guide to Postexposure Rabies Treatment for the Healthcare Professional" is available at the NJDHSS website at URL: www.state.nj.us/health/cd/pxrabies.htm. Representatives of the department's Infectious and Zoonotic Diseases Program are available to assist physicians in making treatment decisions. They can be reached by calling 609-588-3121 or 609-588-7500 between 8 AM and 5 PM on workdays.

IMMUNIZATIONS FOR TRAVEL

Since travel-related vaccination recommendations are updated frequently, information about these vaccinations should be obtained by contacting the NJDHSS, Division of Epidemiology, Environmental and Occupational Health Services at 609-588-3121 (business hours) or 609-392-2020 (nights and weekends) or the Centers for Disease Control and Prevention at URL: www.cdc.gov/travel/vaccinate.htm.

Conclusion

Immunizations are the cornerstone of primary prevention of infectious diseases. The impact of HIV on the immune system requires modification of the usual vaccine schedule for patients with HIV–AIDS. In some instances, vaccines are contraindicated. However, vaccine contraindication does not preclude primary prevention. For example, patients with HIV–AIDS exposed to varicella can receive VZIG.[21] *NJM*

References

1. Centers for Disease Control and Prevention. "Ten Great Achievements in Public Health–United States, 1900–1999," *MMWR* 48 (1999): 241–243.

2. J. Sutcliffe and N. Duin. *A History of Medicine* (New York: Barnes & Noble, Inc., 1992): 40, 212.

3. J. Kovacs and H. Masur. "Prophylaxis against Opportunistic Infections with Human Immunodeficiency Virus Infection," *NEJM* 342 (2000): 1416–1429.

4. J. Bartlett and J. Gallant. "Medical Management of HIV," *Disease Prevention: Prophylactic Antimicrobial Agents and Vaccines*. Available at URL: www.hopkins-aids.edu.

5. New Jersey Department of Health and Senior Services. "New Jersey HIV–AIDS Cases Reported as of March 31, 2001."

6. Centers for Disease Control and Prevention. "Recommended Childhood Immunization Schedule—United States, 2001. 2001," *MMWR* 50: 7–10, 19.

7. Centers for Disease Control and Prevention. "Use of Diphtheria Toxoid-Tetanus Toxoid-Acellular Pertussis Vaccine as a Five-Dose Series," *MMWR* 49, no. 13 (2000): 1–8.

8. Centers for Disease Control and Prevention. "Recommendation for Use of Haemophilus B Conjugate Vaccine and a Combined Diphtheria, Tetanus, Pertussis, and Haemophilus B Vaccine Recommendations of the Advisory Committee on Immunization Practices," *MMWR* 42, no. 13 (1993): 1–15.

9. Centers for Disease Control and Prevention. "Prevention and Control of Meningococcal Disease," *MMWR* 49, no. 7 (2000): 1–10.

10. Centers for Disease Control and Prevention. "Prevention of Hepatitis A through Active or Passive Immunization: Recommendations of the Advisory Committee on Immunization Practices," *MMWR* 48, no. 12, 1999): 1–37.

11. Centers for Disease Control and Prevention. "Notice to Readers: Recommendations to Prevent Hepatitis B Virus Transmission—United States," *MMWR* 44, no. 30 (1995): 574–575.

12. Centers for Disease Control and Prevention. "Notice to Readers: Alternate Two-Dose Hepatitis B Vaccination Schedule for Adolescents Aged 11–15 Years," *MMWR* 49, no. 12 (2000): 261.

13. Centers for Disease Control and Prevention. "Prevention and Control of Influenza: Recommendations of the Advisory Committee on Immunization Practices," *MMWR* 50, no. 4 (2001): 1–44.

14. Centers for Disease Control and Prevention. "Prevention of Pneumococcal Disease among Infants and Young Children: Recommendations of the Advisory Committee on Immunization Practices," *MMWR* 49, no. 9 (2000): 1–38.

15. Centers for Disease Control and Prevention. "Poliomyelitis Prevention in the United States: Updated Recommendations of the Advisory Committee on Immunization Practices," *MMWR* 49, no. 5 (2000): 1–22.

16. Centers for Disease Control and Prevention. "Guidelines for Preventing Opportunistic Infections Among HIV-Infected Persons—2002 Recommendations of the U.S. Public Health Service and the Infectious Diseases Society of New Jersey," *MMWR* 51, no. RR-8 (2002): 19-20.

17. "New Combination Hepatitis A and B Vaccine Wins License," *Hepatitis Control Report* (Spring 2001): 8.

18. Centers for Disease Control and Prevention. "Prevention of Pneumococcal Disease: Recommendations of the Advisory Committee on Immunization Practices," *MMWR* 46, no. 8 (1997): 1–24.

19. S. Tasker and M. Wallace. "Vaccination in HIV-Infected Patients," *Current Infectious Disease Reports* 2 (2000): 247–256.

20. Centers for Disease Control and Prevention. "Measles, Mumps, and Rubella-Vaccine Use and Strategies to Eliminate Rubella Syndrome and Control of Mumps: Recommendations of the Advisory Committee on Immunization Practices," *MMWR* 47, no. 8 (1998): 1–57.

21. Centers for Disease Control and Prevention. "Prevention of Varicella: Updated Recommendations of the Advisory Committee on Immunization Practices," *MMWR* 48, no. 6 (1999): 1–5.

22. Centers for Disease Control and Prevention. "Human Rabies Prevention—United States," *MMWR* 48, no. RR-1 (1999): 19-30.

23. Centers for Disease Control and Prevention. "Compendium of Animal Rabies Prevention and Control," *MMWR* 50, no. 8 (2001): 1–9.

CME Examinations

INSTRUCTIONS

Type or print your full name and address and your date of birth in the spaces provided on the CME REGISTRATION FORM, then record your answers. Retain a copy of your answers.

Complete the evaluation portion of the CME REGISTRATION FORM. Forms and examinations cannot be processed if the evaluation portion is incomplete. Evaluations of this article in no way affect the scoring of the examinations.

Send the completed form to: *New Jersey Medicine,* Medical Society of New Jersey, Two Princess Road, Lawrenceville, NJ 08648; or fax the completed form to: *New Jersey Medicine*, 609-896-1368.

Examinations will be graded, and you will be advised as to whether you have passed or failed. Unanswered questions are considered to be incorrect. A score of at least 70% is required to pass. Answers to the examination will be sent to you along with your CME certificate.

Failed examinations may be retaken.

Be sure to submit the CME REGISTRATION FORM on or before the deadline. Forms received after the listed deadline will not be processed.

CME ACCREDITATION

This CME article is primarily targeted at physicians and other allied health professionals. There are no specific background requirements. This activity has been planned and implemented in accordance with the Essential Areas and Policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint sponsorship of the Academy of Medicine of New Jersey (AMNJ) and the Medical Society of New Jersey (MSNJ). AMNJ is accredited by the ACCME to provide continuing medical education for physicians.

CREDIT DESIGNATION

AMNJ designates this article for a maximum of 1.0 hour in category 1 credit towards the AMA Physician's Recognition Award. Each physician should claim only those hours of credit actually spent.

FULL-DISCLOSURE POLICY

It is the policy of the Academy of Medicine of New Jersey to ensure balance, independence, objectivity, and scientific rigor in all of its educational activities. All authors participating in continuing medical education programs sponsored by the Academy of Medicine of New Jersey are expected to disclose to the audience any real or apparent conflict(s) of interest related to the content of their material. Full disclosure of author relationships will be made in the article.

STATEMENT OF COMPLIANCE

This activity has been planned and implemented in accordance with the Essential Areas and Policies of the Accreditation Council for Continuing Medical Education (ACCME) by the Academy of Medicine of New Jersey.

CME EXAMINATION: DEADLINE SEPTEMBER 30, 2004

"Immunizations in Hiv-Infected Patients"

1. Immunizations for which of the following organisms are contraindicated for HIV-infected adults?
   A. Hepatitis A
   B. Hepatitis B
   C. Influenza
   D. Varicella

2. Which of the following is recommended for a symptomatic HIV-infected person with exposure to measles?
   A. No intervention
   B. Intravenous immune globulin, regardless of vaccine status
   C. Intravenous immune globulin plus single-strain measles vaccine
   D. Single-strain measles vaccine

3. Which of the following should not be administered to an HIV-infected adult?
   A. Inactivated viral vaccine
   B. Live bacterial vaccine
   C. Protein conjugate vaccine
   D. Toxoid vaccine

4. Which of the following antibody levels 1–6 months after the last dose of hepatitis B vaccine is considered protective?
   A. ≥ 1 SRU/ml
   B. ≥ 4 SRU/ml
   C. ≥ 7 SRU/ml
   D. ≥ 10 SRU/ml

5. For which of the following is annual administration of vaccine to HIV-infected adults recommended?
   A. Hepatitis A
   B. Hepatitis B
   C. Influenza
   D. *Streptococcus pneumoniae*

6. Which of the following HIV-infected adults should receive a vaccine for hepatitis A?
   A. Acute case of hepatitis C
   B. Commercial sex worker
   C. Injection drug user
   D. Household contact of a hepatitis A carrier

7. Which of the following best describes the impact of vaccine administration on HIV viral load?
   A. Temporary decrease
   B. Temporary increase
   C. Unchanged

Answer Sheet

"Immunizations in Hiv-Infected Patients"

Darken the correct answers

1. [A] [B] [C] [D] 2. [A] [B] [C] [D] 3. [A] [B] [C] [D]
4. [A] [B] [C] [D] 5. [A] [B] [C] [D] 6. [A] [B] [C] [D] 7. [A] [B] [C]

Time spent reading this article and completing the learning assessment and evaluation: _____HOURS_____ MINUTES

Evaluation Form

(*This must be completed for this examination to be scored.*)

"Immunizations in Hiv-Infected Patients"

Check the appropriate answer below	Yes	No
The objectives were useful in determining if this activity would be a worthwhile educational activity for me.	____	____
The objectives accurately described the content of and potential learning from the article.	____	____
This article will help to modify my practice performance.	____	____
The quiz questions were at an appropriate level for assessing my learning.	____	____

Deadline for mailing: For credit to be received, the envelope must be postmarked no later than September 30, 2004.

Retain a copy of your answers and compare them with the correct answers, which will be sent with your certificate.

Registration Form

(please print or type)

LAST NAME FIRST NAME DEGREE

MAILING ADDRESS

CITY STATE ZIP CODE

DATE OF BIRTH (USED FOR TRACKING CREDITS ONLY)

PHONE NUMBER FAX NUMBER E-MAIL

Send completed form to:
New Jersey Medicine, Medical Society of New Jersey, 2 Princess Road, Lawrenceville, New Jersey 08648,
fax: 609-896-1368